

ChEESE

General project overview (status at M21)

Second General Assembly
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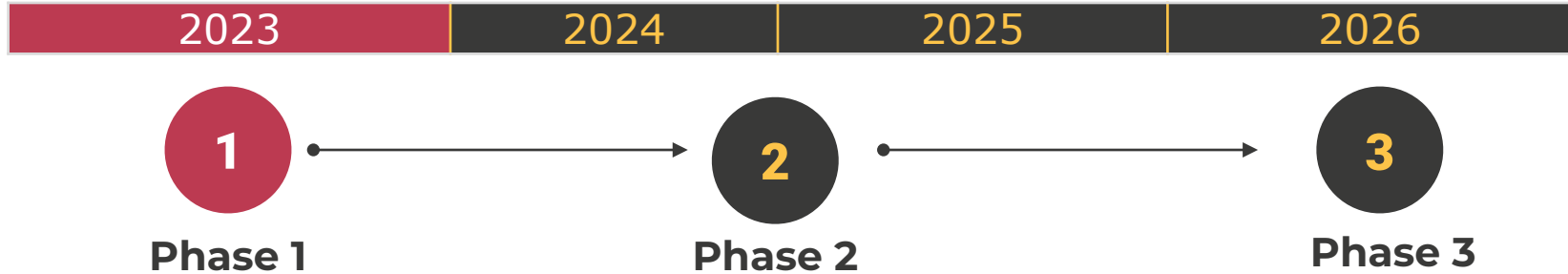
Project funded by EuroHPC under the grant agreement No 101093038.



7 Work Packages

WP	WP Title	Lead Partner	Start Month	End Month	Person Months	Tasks	Deliverables
1	Project Management	CSIC	1	48	78	5	5
2	Exascale technical challenges in flagship codes	CIN	1	48	247	4	4
3	Co-design with European HPC vendors and technologies	BA	6	42	86	3	2
4	Simulation ecosystem	HLRS	1	48	95	3	5
5	Farming Pilot Demonstrators	CNRS	1	42	235.5	2	10
6	Simulation cases and service enabling using EuroHPC infrastructures	INGV	13	48	165	4	12
7	Dissemination, outreach and community building	BSC	1	48	70.5	6	8
	TOTAL				976	27	46

Implementation phases



- **Project setup and overall planning**, including quality guidelines (**D1.1**), Data Management Plan (DMP; **D1.2**), communication and dissemination plans (**D7.1**, **D7.2**), and training plan (**D7.4**).
- Collaboration plan with complementary projects (**D7.3**) including other CoEs and NCCs.
- **First code audit campaign** to quantitatively set the baseline level of codes using hybrid POP metrics (**D2.1**) and drive the subsequent WP2-WP3 code optimisation activities.
- Collection of requirements for the 7 **mini-apps** (**D3.1**) and for implementation of workflows and PDs.
- Early deployment of selected codes on EuroHPC systems following a **CI/CD** approach (**MS10**).
- Provision of **computational resources** for transversal WP2-WP4 activities, at this stage only through **benchmark** and **development** access modes on EuroHPC systems.

Implementation phases

2023

2024

2025

2026

1

Phase 1

2

Phase 2

3

Phase 3

- Increase the **performance portability** of codes across different NVIDIA/AMD accelerators (**D2.2**).
- Quantify improvements by updating the POP metrics after second audit round (**MS5** and **D2.3**).
- **Co-design** with EuroHPC Pilots using the 7 mini-apps (**MS2**).
- Implement **new functionalities** (physics, couplings) in the codes as required by the PDs and periodic new code releases pushed to open git-based repositories and EuroHPC systems (**MS3**, **D5.1**).
- Further implementation of workflows (**D4.2**, **D4.3**) and the 9 PDs (**D5.2** to **D5.10**).
- **Setup of the Simulation Cases** (SCs) and trials (**D6.1**).
- Provision of **computational resources** through EuroHPC **regular** and **extreme-scale** modes.
- Execute the **first production runs** for the capability and capacity SCs.
- Draft a preliminary exploitation plan (**D7.5**).

Implementation phases

2023

2024

2025

2026

1

Phase 1

2

Phase 2

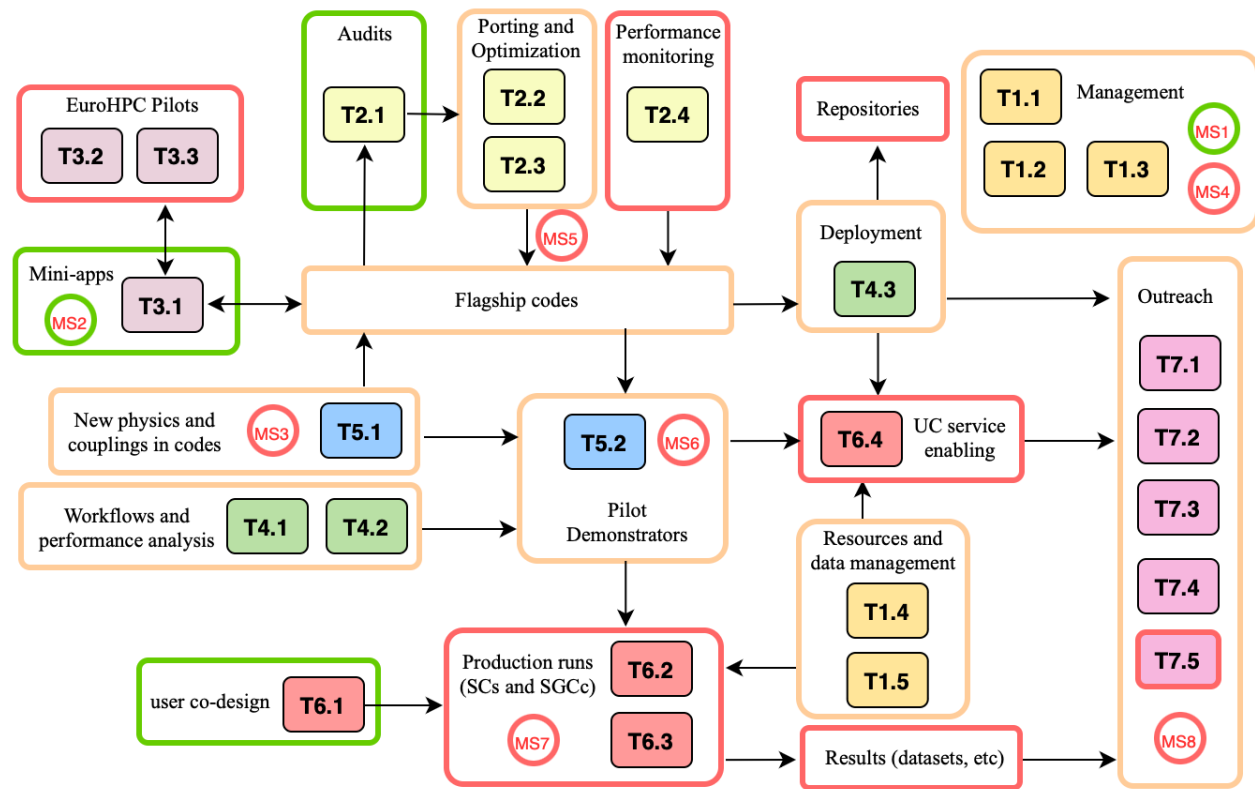
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Phase 3

- Final **deployment of the 9 PDs** (**MS6**).
- Complete the 15 SCs through **production runs** and generate EOSC-enabled datasets integrated in the European Plate Observing System (EPOS) and elsewhere as detailed in the DMP (**MS7** and **D6.2** to **D6.11**).
- Enable **4 Urgent Computing (UC) services** on target tier-0 EuroHPC pre-exascale architectures (Leonardo, LUMI, MN5) for an emergency access mode (**MS8**, **D6.12**).
- Perform user-driven **evaluation trials and exercises** in collaboration with members of the Industry and User Board (IUB).



Milestones and task dependencies: overall status at M21



ChESEE-2P Pert diagram showing milestones and task dependencies (M21). The following legend is used:



Deliverables at M21 (11/46)

WP	Number	Deliverable name	Month	Contents
1	1.1	Project management and quality guidelines	2	Describes the project's internal management procedures as defined in T1.1
	1.2	First Data Management Plan	6	Describes the management life-cycle for all the digital assets to be collected, processed, and generated
	1.3	Mid-term report	32	Technical report describing the activities performed up to second reporting period (M30)
	1.4	Final Data Management Plan	34	Updated (final) version of the DMP
	1.5	Final report	48	Technical report describing the project activities performed up to the end of the project
2	2.1	First code audit report	12 (13)	First code audit round results and the recommendations arising from the analyses
	2.2	First report on improving code performance at exascale	24	Report on porting, optimisation and tuning for the selected applications
	2.3	Second code audit report	30	Update of D2.1 and further recommendations arising from the analysis
	2.4	Final report on improving code performance at exascale and Best Practice Guide	48	Technical report describing the achieved scalability level and related performances obtained for the selected applications



Deliverables at M21 (11/46)

WP	Number	Deliverable name	Month	Contents
3	3.1	Selected set of mini-apps and its requirements	12	Provide an account of hardware and software requirements of the already existing mini-apps
	3.2	SE Community applications on European HPC technologies	42	Lessons learnt to use the prototypes from EuPEX and EuPilot
4	4.1	Initial report on workflow setups and workflow auditing	18	Report describing the initial workflows and their set up including audit results for (selected) workflows
	4.2	Plan for development and deployment tool usage for workflows and software	20	Report outlining intended code/workflow development and deployment tools in T4.3, for use with PDs/SCs
	4.3	Intermediate report on workflow setups and optimization	30	Report summarising changes, improvements and optimisations made to workflows including the adaptation of new deployment methods
	4.4	Final report on workflow implementation and optimization	42	Comparison of final implementations and improvements against the initial workflows
	4.5	Final report on development and deployment activities	44	Overview of adaptation and use of development and deployment tools in the project



Deliverables at M21 (11/46)

WP	Number	Deliverable name	Month	Contents
5	5.1	New version release of flagship codes	24	Code version releases with the new functionalities
	5.2	Demonstrator of PD1	30	Demonstrator on extreme-scale modeling of seismic hazards
	5.3	Demonstrator of PD4	30	Demonstrator on complex multi-source tsunami modeling
	5.4	Demonstrator of PD6	30	Demonstrator on multiphase 3D volcanic explosion modeling
	5.5	Demonstrator of PD7	30	Demonstrator on the Earth's dynamo model
	5.6	Demonstrator of PD8	30	Demonstrator on geodynamics to geohazards
	5.7	Demonstrator of PD2	36	Demonstrator on seismic inversion and tomography
	5.8	Demonstrator of PD3	36	Demonstrator on global probabilistic tsunami hazard and UQ
	5.9	Demonstrator of PD5	36	Demonstrator on ensemble-based volcanic dispersal at scales
	5.10	Demonstrator of PD9	36	Demonstrator on glacial outburst floods



Deliverables at M21 (11/46)

WP	Number	Deliverable name	Month	Contents
6	6.1	Simulation Cases and Trials definition	18	Report on the methodology and precise setup for the production runs
	6.2	SCs report and datasets from PD1	46	SCs report and datasets from PD1 (SC1.1, SC1.2, SC1.3)
	6.3	SCs report and datasets from PD2	46	SCs report and datasets from PD2 (SC2.1)
	6.4	SCs report and datasets from PD3	46	SCs report and datasets from PD3 (SC3.1)
	6.5	SCs report and datasets from PD4	46	SCs report and datasets from PD4 (SC4.1)
	6.6	SCs report and datasets from PD5	46	SCs report and datasets from PD5 (SC5.1, SC5.2)
	6.7	SCs report and datasets from PD6	46	SCs report and datasets from PD6 (SC6.1, SC6.2)
	6.8	SCs report and datasets from PD7	46	SCs report and datasets from PD7 (SC7.1)
	6.9	SCs report and datasets from PD8	46	SCs report and datasets from PD8 (SC8.1, SC8.2)
	6.10	SCs report and datasets from PD9	46	SCs report and datasets from PD9 (SC9.1, SC9.2)
	6.11	Open Hazard Maps	47	Tsu HM (SC3.1) and European THM (SC5.1) for EPOS TCS
	6.12	Urgent computing service enabling	48	Report and demonstrators on user-driven UC services



Deliverables at M21 (11/46)

WP	Number	Deliverable name	Month	Contents
7	7.1	Project website	2	Release of ChEESE-2P project website with information about the project
	7.2	Communication and Dissemination Plan	3	Details activities to be undertaken as part of an overall project communication strategy
	7.3	Collaboration plan with complementary projects	6	Details the plan to ensure efficient collaboration with other CoEs for HPC applications and NCCs
	7.4	Training Plan	8	Identifies the training needs of researchers and other target audiences
	7.5	Preliminary exploitation plan	30	Fisrt version of the exploitation plan
	7.6	Training Report	42	Document compiling all the feedback gathered from participants
	7.7	Exploitation Plan	47	Plans for exploiting the project outcomes, market analysis
	7.8	Communication and Dissemination Report	48	Report on all activities undertaken in T7.1 and T7.2 from M1 to M48



Milestones at M21 (3/10)

MS	Name	M	KPIs	M21 (%)
MS9	Complementary Grants	6	Collaboration agreement (COLA) has been signed	100
MS1	Project setup phase	8	Internal management and communication tools in place, website operative, communication, data management and training plans defined	100
MS10	Application deployment	12	Applications developed by ChEESE-2P made available to users of EuroHPC	50
MS2	Preparation of mini-apps	18	Effective co-design with EuroHPC Pilots can start (D3.1)	100
MS3	Flagship code functionalities	24	Code version releases with the new functionalities (physics) available repository (D5.1)	50
MS4	Mid-term review meeting	25	Check of the project program development (D1.3)	50
MS5	Exascale code preparation	36	Improvements in the flagship codes performance metrics after the second code audit round (D2.2, D2.3)	too early
MS6	Exascale pilot deployment	42	PDs tested successfully (D4.4, D5.2 to D5.10)	too early
MS7	Production runs	48	SCs executed, EOSC-enabled datasets produced (D6.x)	too early
MS8	Community building and sustainability	48	UC services enabled, evaluation exercises with IUB members done, effective liaison with ecosystem initiatives, training completed	too early



KPIs (periodically monitored by CASTIEL-2)

SO	Target(s)	Means of verification (KPI)	M12	M18	Comment
1	Port to accelerators (e.g. NVIDIA/AMD) and fine-tune the codes already accelerated in the first project phase	All codes accelerated at the end of the project	7	8	
	Increase the performance portability of codes across tier-0/tier-1 EuroHPC systems	Performance metrics on Leonardo, LUMI and MN5 machines	-	-	Too early to evaluate
	Perform further single-node optimisation including vectorisation, intra-node communication efficiency, and multi-threading	Continuous run-time performance efficiency monitoring metrics from the TALP tool	-	-	Task starts at M25
2	Obtain code performance metrics (and optimize on-demand accordingly)	Increase in the POP metrics after the second audit round (D2.3)	-	baseline	Second audit campaign
3	Engage with EuroHPC EuPEX and EUPilot projects to test on the available prototypes	The 7 mini-apps tested and with feedback integrated to main codes	-	-	Hardware prototypes are not available yet. Mini-apps are in place (D3.1)
4	Reduce bottlenecks in exascale capacity workflow execution	Increase workflow audit metrics	-	-	
	Automate the code deployment process	CI, static and dynamic code analysis in place	1?	2?	Waiting for CASTIEL2
5	Farm 9 PDs	Increase the TRL of each PD by at least 2 points	-	-	On-going



KPIs (periodically monitored by CASTIEL-2)

SO	Target(s)	Means of verification (KPI)	M12	M18	Comment
6	Run the 6 capacity and 6 capability use cases	Production runs performed and EOSC-enabled results/datasets available	-	-	Too early to evaluate
	Run 4 SGCs (SC1.2, SC2.1, SC4.1, SC8.1; see Sec. 1.2.5)		-	-	Too early to evaluate
	Apply to EuroHPC (and PRACE if not discontinued) for competitive project access resources	Obtain 3 regular and 1 extreme scale EuroHPC competitive access projects	-	-	Too early to evaluate
7	Ensure FAIR validation of datasets, including EPOS-enabled metadata descriptors	Datasets integrated and/or compatible with EPOS standards	-	-	SQAaaS done; git-based repo with ma-DMP
8	Deliver a novel, high-resolution and uncertainty-based global tsunami model hazard map and related services	D6.4 (EPOS-TCS) and datasets available	-	-	Too early to evaluate
	Deliver the first multi-source European tephra hazard map at scale		-	-	Too early to evaluate
9	Enable resilient UC services	4 UC service workflows tested and enabled on different tier-0 EuroHPC systems	-	-	Too early to evaluate



KPIs (periodically monitored by CASTIEL-2)

SO	Target(s)	Means of verification (KPI)	M12	M18	Comment
10	Foster the end-user usage and uptake of codes through application deployment	git-based repositories in place	✓	✓	EOSC-synergy badges
	Organize the Galileo Conference "Solid Earth and Geohazards in the Exascale Era" (May 2023)	Publication of the consensual roadmap white paper	✓	✓	
11	Coordinate with the NCCs and PATC in the organisation of open, free, and gender and country-balances (EU-13) training events and seminars	Organise 7 training events, including at least 1 course for each flagship code	1	4	
12	Engagement of target end-users related to industry, academia, public bodies and policy makers and update the service strategy	Update the market analyses for the new service-oriented use cases	22	25	Organisation of trials
13	Coordinate with SE/HPC ecosystem in all phases of the definition, implementation, validation and evolution of ChEESE-2P activities	Successful activity of the liason officers	11	11	In place
14	Foster awareness of the project and its aims	Quantitative indicators in deliverable D7.6 (	-	-	Too early to evaluate
	Activities of the ChEESE initiative		-	-	Overtaken by the EC



KPIs (periodically monitored by CASTIEL-2)

SO	Target(s)	Means of verification (KPI)	M12	M18	Comment
15	Complementary grants	Number of applications deployed to JU system incl. breakdown by partition (e.g. CPU, GPU)	11	11	
		Number of EuroHPC systems supported by applications incl. breakdown by partition (e.g., CPU, GPU)	4	7	
		Number of errors (failed deployment/ regression tests) identified through common platform	-	-	How to evaluate?
		Average time from failed application test to deployment of corrected application	-	-	How to evaluate?



Other KPIs (miscellanea)

	M12	M21	KPI M48	Comments
Q1 publications	11	19	30	1 Science and 2 Nature Communications
Conferences	10	23	60	
Videos	2	2	1	
Communication activities	30	45	NA	
Press release	1	1	3	
Online webminars	5	7	NA	
Training courses	1	4	7	6 belong to the HPC for geosciences series
Liaison Officers appointed	10	10	NA	with REA/HE projects, other CoEs, DestinE
Industry and Users Board (IUB)	25	26	NA	10 are full members (with NDA signed)
Equality Committee	7	6	NA	



Training courses

Theme	No	Title/Topic	Date	Location	Participants
HPC for Geosciences Series	1	2023 High-Performance Seismology CyberTraining	9-12 May 2023	Online	
	2	Computational volcanology	11-14 Mar 2024	Barcelona (BSC)	16
	3	Tsunami and Meteo-tsunami modelling	13-14 Mar 2024	Online	46
	4	Computational geodynamics	25-28 Mar 2024	Mainz	17
	5	Computational seismology I	Spring 2025	Online	-
	6	Computational seismology II	Autumn 2025	Online	-
Artificial Intelligence	7	Artificial Intelligence and Machine Learning for Geosciences	5-7 Nov 2024	Barcelona (CSIC)	24



Workshops and seminars

No	Date	Theme	Title/Topic	Participants
1	24 Mar 2023	Other	ChEESE training event on EOSC-Synergy tools for SQAaaS	29
2	16 Jun 2023	Programming interfaces and languages	Porting to GPU a Fortran code using intrinsic parallelism	48
3	28 Jun 2023		OpenCL GPU programming for HPC Applications	55
4	07 Jul 2023		Kokkos: A portable programming library for the exascale era	25
5	20 Dec 2023		Device accelerated solvers with PETSc	37
6	29 Apr 2024	Other	Good science in EuroHPC CoEs: incorporating gender analysis in research	50
7	10 Dec 2024		How European projects are developing HPC-based software services to address natural hazards	



EuroHPC benchmark/development access

Code	Project reference	System	node/h	Start	End
SeisSol	EHPC-DEV-2023D07-031	Leonardo	3,500	14/07/2023	14/07/2024
	EHPC-DEV-2023D07-033	LUMI-G	10,000	03/07/2023	03/07/2024
SPECFEM3D	EHPC-DEV-2023D08-039	Leonardo	3,500	07/08/2023	07/02/2024
ExaHyPE	EHPC-DEV-2023D03-043	Leonardo	3,500	15/08/2023	15/08/2024
Tandem	EHPC-DEV-2023D10-044	LUMI-C	15,000	25/10/2023	25/10/2024
		LUMI-G	10,000	12/10/2023	12/10/2024
		Leonardo	3,500	16/10/2023	16/10/2024
xSHELLS	EHPC-DEV-2023D05-049	VEGA	1,000	01/06/2023	01/06/2024
HySEA	EHPC-BEN-2023B06-047	VEGA	400	15/06/2023	14/09/2023
	EHPC-DEV-2023D09-03	Leonardo	3,500	25/09/2023	25/03/2024
FALL3D	EHPC-DEV-2023D07-008	Leonardo	3,500	01/09/2023	31/08/2024
	EHPC-DEV-2023D10-028	LUMI-G	10,000	15/10/2023	15/10/2024
	EHPC-DEV-2024D09-010	Leonardo	4,500	-	-
	EHPC-DEV-2024D09-012	LUMI-G	4,500	-	-
OpenPDAC	EHPC-DEV-2023D08-044	LUMI-C	15,000	30/09/2023	31/03/2024
LAMEM	project_465000139	LUMI-C	4,000	13/10/2023	01/02/2024
	EHPC-DEV-2024D02-017	LUMI-G	10,000	01/02/2024	01/02/2025
pTatin3D	EHPC-BEN-2023B10-018	LUMI-G	12,000	15/10/2023	29/02/2024
TOTAL			117,400		



EuroHPC regular/extreme access: resource estimation

SCs	Concept	Mode	Type	System	node/h	Contact
1.1	Noise and seismicity	capability	Extreme	Leonardo	350,000	Vadim
2.1	Seismic tomography	capability	Extreme	Leonardo	320,000	Emmanuele
8.1	Etna system and landslides	capability	Extreme	LUMI-C	300,000	Boris/ Iskander
8.2	Hellenic arc 3D tectonic evolution	capability	Regular	LUMI-C	75,000	Anthony/Laetitia
4.1	Tonga	capability	Regular	Leonardo	120,000	Finn/Clea
3.1	Global tsunami HM	capacity	Regular	Leonardo	100,000	Stefano/Jorge
5.1	European tephra HM	capacity	Regular	MN5-ACC	37,000	Laura/Arnau
7.1	AI for MHD	capacity	Regular	VEGA-GPU	34,000	Alexander/Nat
6.1 + 6.2	Phreatic eruptions	capacity (UC)	Regular	LUMI-C	60,000	Tomaso
1.2 (1&2)	Hellenic arc and EAF earthquake simulators (SeisSol)	capacity	Regular	Leonardo	105,000	Claudia/Alice
1.2 part 3	SW Iceland Seismic Cycle simulation (Tandem)	capacity	Regular	LUMI-C	65,000	Thomas U
1.3 (1&2)	Dynamic EQ source inversion and Physics-based PSHA	capacity	Regular	MN5-GPP	220,000	Nico/Claudia
1.3 part 3	Cybershake data generation and ML for PSHA and UC	capacity (UC)	Regular	MN5-GPP	114,000	Marisol
9.1+9.2	Glacial lake outburst floods and glacier calving	capacity	Regular	LUMI-C	100,000	Thomas Z



EuroHPC regular/extreme access: proposal strategy

System	Autumn 2024		Spring 2025		Autumn 2025	
	Regular	Extreme	Regular	Extreme	Regular	Extreme
MN5-GPP	SC1.3 (part 3)		1.3 (parts 1&2)		Buffer to be used as a second (and last) tentative	
MN5-ACC	SC5.1		1.2 (parts 1&2)			
Leonardo	SC3.1 (postponed)	SC1.1	SC4.1	SC2.1		
LUMI-C	SC6.1 + SC6.2		SC9.1 + SC9.2	SC8.1		
LUMI-G						
Meluxina-CPU			SC 1.2 (part 3)			
Meluxina-GPU						
VEGA-CPU	SC8.2					
VEGA-GPU	SC7.1					

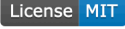


EuroHPC regular/extreme access: submitted (autumn 2024)

Sc	Proposal title	Reference	System	node/h
1.1				
1.3 (part 3)	CyberShake physics-based simulations for machine learning ground motion forecasting in South Iceland	EHPC-REG-2024R02-131	MN5-GPP	113,636
5.1	Towards the European tephra hazard map	EHPC-REG-2024R02-128	MN5-ACC	36,700
6.1 - 6.2	High-Resolution Multiphase-Flow Simulation of Phreatic Volcanic Explosions	?	LUMI-C	60,000
7.1	MHD turbulence in the Earth's core	EHPC-REG-2024R02-186	VEGA-GPU	34,000
8.2				
TOTAL				



SQAaaS (badges for code repositories)

Name	SQAaaS	DOI	Version	License
SeisSol				
SPECFEM				
Tandem				
xSHELLS		Reference		
HySEA				
FALL3D				
OpenPDAC				
LaMEM				
pTatin3D		Reference		
ELMER_ICE				
ExaHyPE				



Follow-up from 1st review report

	Recommendation	Action
R1	The focus in the activities oriented to achieve pre-exascale should be a priority in the project. The design of workflows should be focused in achieving this objective and not only a mere automatisisation of manual processes	?
R2	Improve the reporting of the activities performed in the year of evaluation	Will be considered in next report (M30)
R3	All tasks with activities during the monitoring period should be informed, not only those that have associated deliverables	
R4	It is important to make more efforts in measuring the impact of the project activities. For instance in terms of the number of users of the selected codes, community etc	See CASTIEL-2 KPIs
R5	It is recommended to perform training actions more focused in the use of the selected codes	WP7 activities focussed on codes
R6	Related to [R1] it is recommended to establish a close collaboration with POP3 as soon as possible to ensure that tasks related to performance optimisation of codes can start and will not be further delayed	Done, issue corrected
R7	The activities reported in WP5 related to the automation of workflows, for example, for codes that are running in parallel and communicating with each other, is appreciated by the reviewers. However, as the reported activities cover mainly automation of manual interaction, it is recommended to clarify within the deliverables of the next reporting period how these steps fit into the exascale ambition of this CoE.	Will be considered in next report (M30)

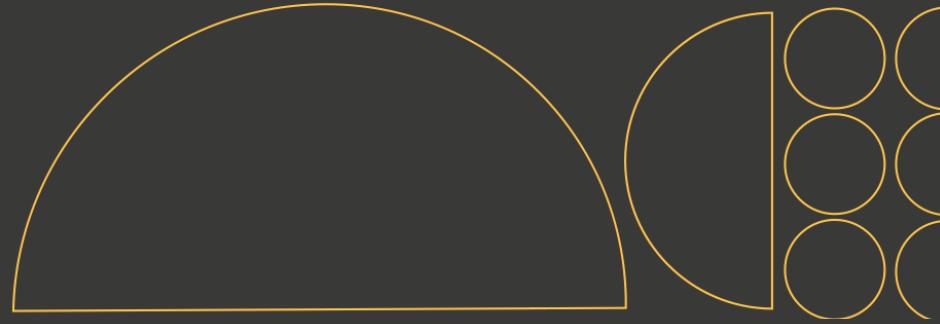


Follow-up from 1st review report

	Recommendation	Action
R8	Related to [R4] the role of the Industry and Users Board (IUB) should be clarified. It is strongly recommended to clarify the role of the board and who will engage in those tasks related to industry, market assessment or else where this board may not be well prepared to contribute to.	WP6 trial exercises
R9	Provide a more detailed description on the CoE's activities regarding collaboration with the twin projects CASTIEL2 and EuroCC2.	Will be considered in next report (M30)
R9.1	CI/CD: The common integration and deployment platform requires input from the CoEs regarding technical requirements and pre-requisites. It is therefore recommended to proactively liaise with CASTIEL2 to ensure technical requirements and interests of this CoE are appropriately considered	See Heribert's talk
R9.2	C2ISS: The information sharing system similarly requires input from the CoEs. It is recommended to proactively liaise with CASTIEL2 to ensure that this CoE's requirements are considered, and that work performed within this CoE's work packages will neither become duplicate nor lost	ok
R9.3	It is recommended that respective activities (a, b) are closely monitored by the affected work packages of this CoE and advances recorded and presented in the next reporting period.	Will be considered in next report (M30)



Thank you!



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